

## 0.1 Optimal Control of Pitch/Travel without Feedback

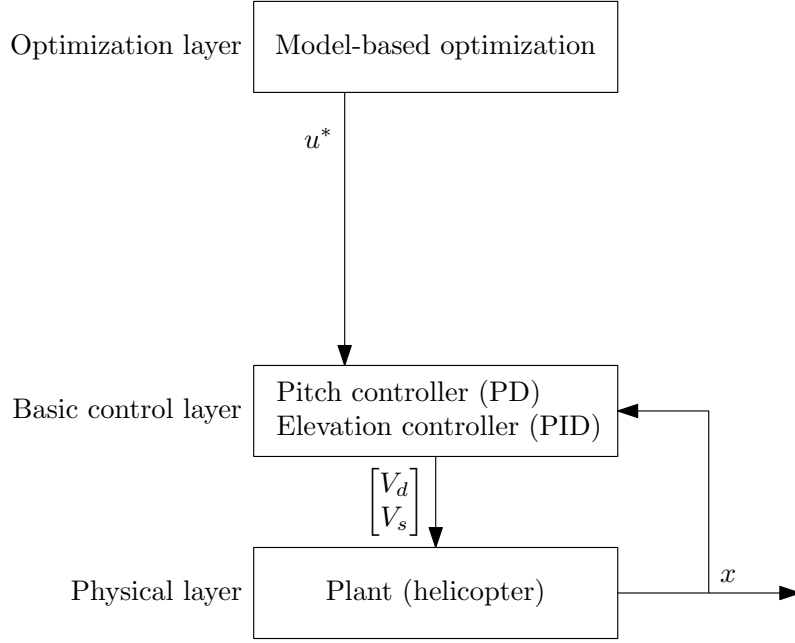


Figure 1: A figure created with Ipe for TTK4135.

$$\dot{\mathbf{x}} = A_c \mathbf{x} + B_c \mathbf{u} \quad (1)$$

$$A_c = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & -K_2 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & -K_1 K_{pp} & -K_1 K_{pd} \end{bmatrix}, \quad B_c = \begin{bmatrix} 0 \\ 0 \\ 0 \\ K_1 K_{pp} \end{bmatrix}$$

$$\begin{aligned} \mathbf{x}_{k+1} &= \mathbf{x}_k + h \dot{\mathbf{x}}_k \\ &= \mathbf{x}_k + h(A_c \mathbf{x}_k + B_c \mathbf{u}_k) \\ &= (I + h A_c) \mathbf{x}_k + h B_c \mathbf{u}_k \end{aligned}$$

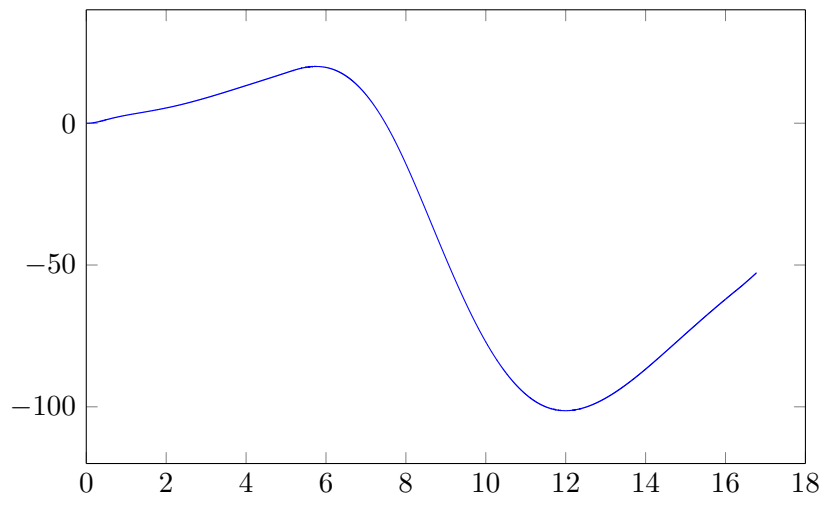


Figure 2: travelunderUnderModelbasis

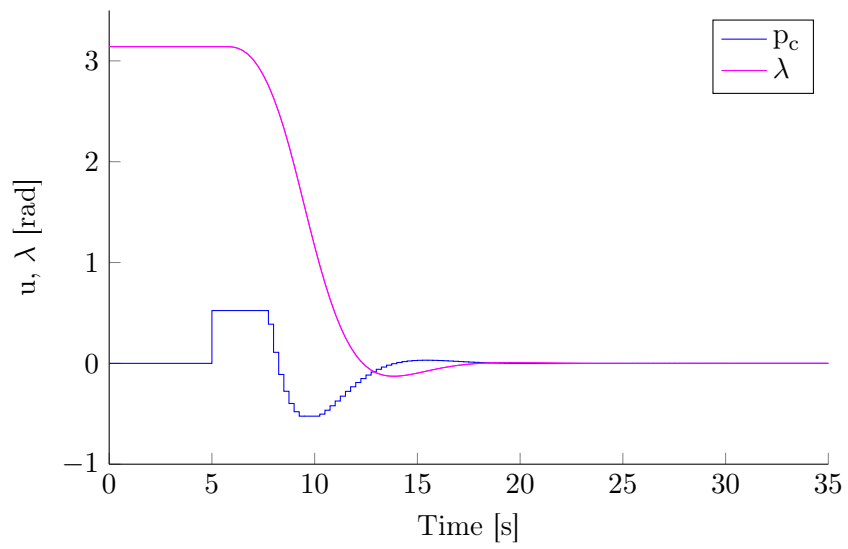


Figure 3: someOtherName

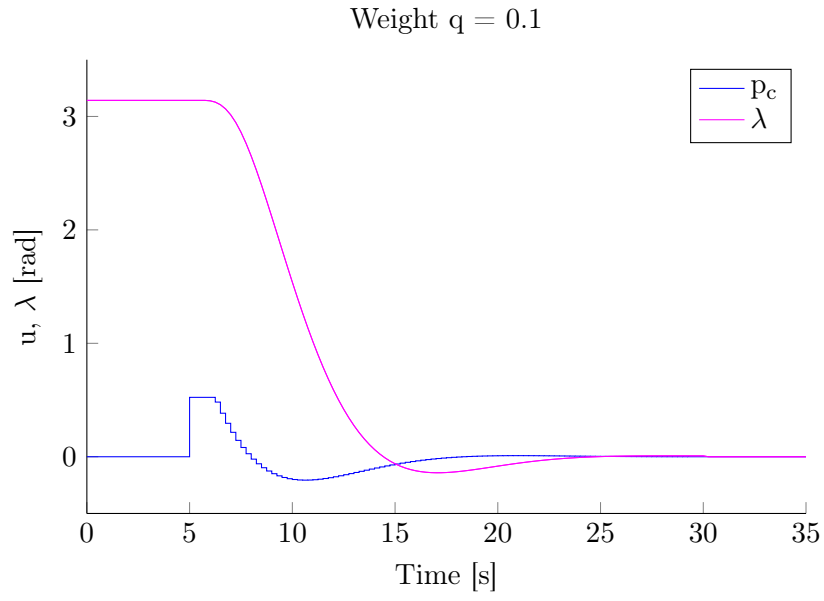


Figure 4: zeroPointOneQ

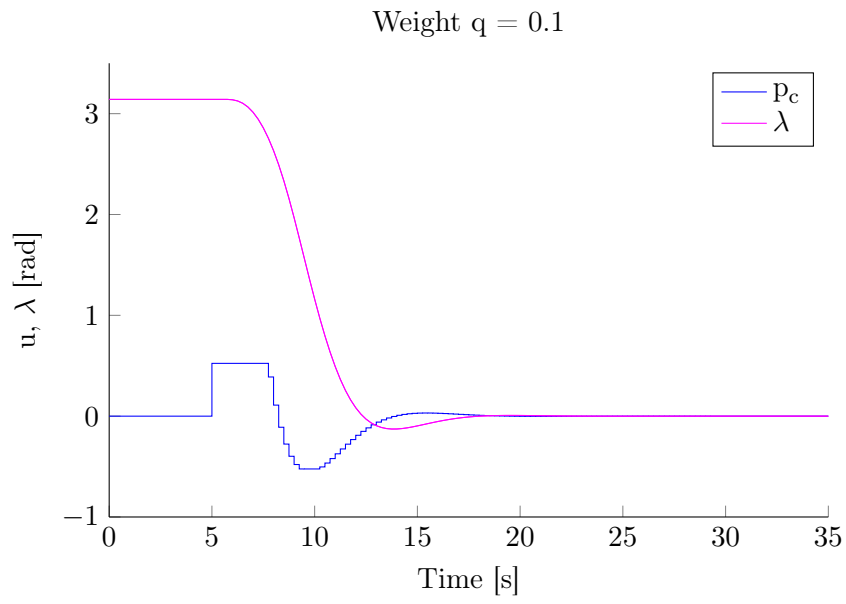


Figure 5: oneQ

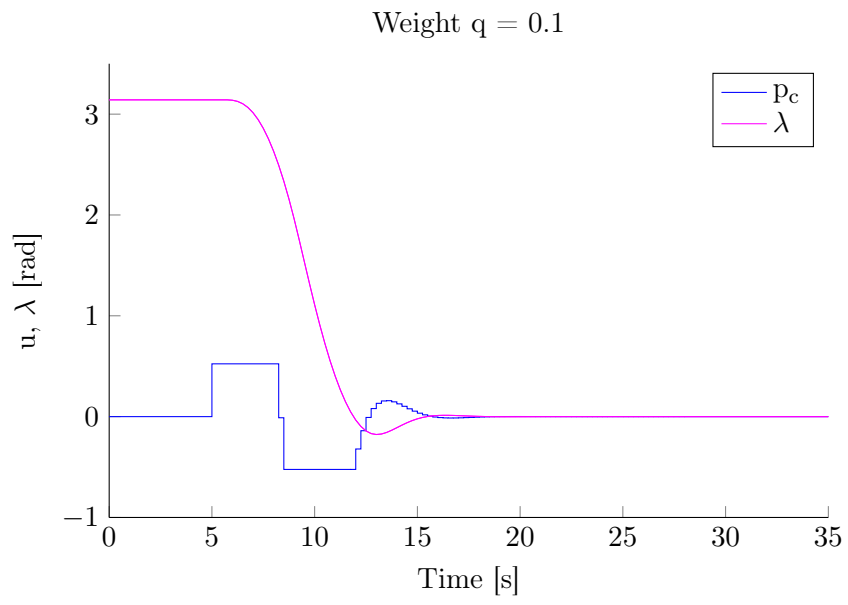


Figure 6: tenQ